HOUSEHOLD FOOD SECURITY AND COVID-19 PANDEMIC IN NIGERIA

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Abstract

Pivotal to human development and the sustainable development goals is food security which remains of substantial concern globally and in Nigeria, particularly during the COVID-19 pandemic despite various palliatives and intervention initiatives launched to improve household welfare. This study investigated the food security status of households during the pandemic and examined its determinants using the COVID-19 National Longitudinal Phone Survey (COVID-19 NLPS).

In analysing the data, descriptive statistics, bivariate as well as multivariate analysis were employed. Findings from the descriptive statistics showed that only 12% of the households were food secure, 5% were mildly food insecure, 24% were moderately food insecure, and over half of the households (58%) experienced severe food insecurity. The result from the ordered probit regression identified socioeconomic variables (education, income and wealth status) as the main determinants of food security during the pandemic.

This study indicates that over 60 per cent of the households' lives were threatened by food insecurity in Nigeria. The finding indicates gross inadequacy of government palliative support and distribution. Thus, in reference to policy implication, interventions and palliatives should be well planned and consistent with household size and needs.

Keywords: *Food Security, Household, COVID-19, Ordered Probit model, Nigeria,*

1.0 Introduction

The globalisation of a human, health and economic crisis which emerged from the Wuhan province of China in December 2019 disrupted the global development agenda and the economic plans of all nations across the globe through its spillovers (Bank World, 2020). To control the spread of this pandemic, countries immediately commenced the lockdown, self-isolation and social distancing approach given the rapid increase in the number of infected persons. These unanticipated restrictions in physical, social and economic activities interrupted the ability to earn a living and affected economic sectors at different levels ranging from the primary sector to manufacturing and services; thereby, threatening the achievement of the second sustainable development goal targeted at ending hunger, achieving food security and improved nutrition (Nicola et al., 2020; Niles et al., 2020)

As a social determinant of health and sustainable development (McIntyre, 2003), food security is of global concern with about 10% of the world's population and 19% of Africans severely food insecure (Food and Agriculture Organization of the United Nations [FAO] et al., 2020). That is, they have limited access to sufficient food due to inadequate financial capacity and other resources (Nord, Andrews, & Carlson, 2005). Besides, with a Global Hunger Index (GHI) score of approximately 28 suggesting a serious level of hunger in Nigeria (GHI, 2019), and the possibility of COVID-19 pandemic increasing the total number of the undernourished people in the world by 83 to 132 million in 2020 (FAO et al., 2020), achieving food security for every Nigerian continues to be a challenge, despite the recent agricultural intervention policies geared towards minimizing reliance on food imports while increasing domestic production.

Following the world food crisis, discussions around food security have been topical, particularly in developing countries, and several recent documents (Canadian Security Intelligence Service

[CSIS], 2020; FAO, 2020; Swinnen & McDermott, 2020; World Bank, 2020; Akiwumi, 2020; World Health Organization [WHO], 2020), as well as peer-reviewed literature (Abate, Brauw, & Hirvonen, 2020; Shupler, Mwitari, Gohole, & Cuevas, 2020; Udmale, Pal, Szabo, Pramanik, & Large, 2020; Wolfson & Leung, 2020), have documented the possible effect of COVID-19 pandemic on food security given different scenarios. While the World Food Programme (WFP, 2020) suggest that the pandemic could lead to a doubling of the number of persons facing acute food insecurity in low and middle-income countries (LMICs), including Nigeria, (Wolfson & Leung, 2020; Arndt et al., 2020) suggests that measures deployed to minimize the spread of COVID-19 will disproportionately affect households with low levels of income and jeopardise household food security.

In a country like Nigeria where food insecurity had been a challenge prior to the compound impact of COVID-19, there exists sparse empirical documentation of this dynamics. It is imperative to examine the household food security during the early stages of the pandemic, while also investigating the determinants of food security among households during COVID-19 pandemic. Based on the foregoing, the rest of the paper is sectioned as follows. The second section covers the review of the conceptual and empirical literature; the third section oversees the methodology of this study, while the fourth section contains the discussion of results. The study is concluded in the fifth session.

2.0 Review of Literature

This empirical review of literature is categorised into the review of conceptual literature on food security, the determinants of food security at both the individual and the household level and a review of studies that have examined the association between COVID-19 and food security globally.

The multifaceted concept of food security has received unwavering attention and economic importance since the 1974 World Food Conference where the issues of hunger, famine and food crisis were discussed extensively (United Nations, 1974). Although it has undergone various developments over the years, food security is conceptualized as "a situation that exists when all people, at all times, have physical, social and economic access to sufficient, safe and nutritious food that meets their dietary needs and food preferences for an active and healthy life" (FAO, 2002). That is, a situation in which "all people, at all times, are free from hunger" (WFP, 2012, p. 170). This multidimensional definition is hinged on four pillars namely; availability or the adequacy of food supply, food accessibility or affordability, the stability of supply without shortages or seasonal fluctuations and, utilisation (Applanaidu, Bakar, & Baharudin, 2014).

The determinants of food security which have been investigated in various contexts of developed (Nord, Andrews & Carlson, 2008; Olabiyi & McIntyre, 2014) and developing countries (Gebre, 2012; Applanaidu et al., 2014; Ahmadi & Melgar-Quiñonez, 2019) differs across the global, national and household levels. While (Kopnova & Rodionova, 2018) whose study examined the determinants of food security using time series data found population growth and foreign aid as the dominant determinants, studies that utilized household data in the different rural and urban context identified socio-demographic and economic status among other factors as the major determinants of food security or insecurity (Amaza, Umeh, Helsen, & Adejob, 2006; Arene & Anyaeji, 2010). Specifically, Harris-Fry et al. (2015) employed a multinomial logistic regression in identifying household wealth status, increased household size, women's literacy and freedom to access market as the dominant factors influencing food security in Bangladesh. Meanwhile, Ngema, Sibanda and Musemwa (2018) whose study employed a binary logistic regression approach also identified the level of education, income, infrastructural support and access to credit

as the major determinants of food security. Applying a similar regression as Ngema et al. (2018), Abdullah et al. (2019) noted that remittances, inflation, gender, assets, unemployment, age and diseases are the determinants of food insecurity in Pakistan. More recently, Sisha (2020) discovered that a higher level of education, increased wealth status, proximity to service centres and residing in an urban area minimizes the risk of food insecurity whereas households with a high dependency ratio and households that experienced shocks are at a higher risk of experiencing food insecurity.

The socio-economic effect of COVID-19 is been studied extensively across and within countries and there is also a growing body of literature investigating the nexus between COVID-19 and food security amongst other indicators of sustainable development. For instance, a cross-sectional study of 1478 low-income adults in the United States (Wolfson & Leung, 2020) showed that 44% were food insecure, 36% were food secure and 20% experienced marginal food security in the early stages of the pandemic. Besides, the effects of COVID-19 were magnified among food-insecure and low-income households and it was disproportionately distributed among communities with coloured individuals. During the early weeks of the stay-at-home order in Vermont, Niles et al. (2020) assessed food insecurity prior to and during COVID-19 and found 36% of new households with food insecurity, while also noting that individuals who had experienced a job loss had a higher odds of experiencing food insecurity. Alvi and Gupta (2020) argued that the effect of COVID-19 on food security and education will be more severe for girls and children who are already from disadvantaged ethnic groups, while findings from Udmale et al. (2020) suggests that 15 African countries, 4 Asian countries, 10 Latin American countries and 6 countries from Oceania among other developing countries are at a greater risk of transitory food insecurity.

Focusing on Africa, Shupler et al. (2020) discovered that during the lockdown, 88% of the respondents from a Kenyan informal settlement were food insecure while a survey of 600 Ethiopian households conducted by Abate et al. (2020) found that two-thirds of the respondents observed a decline in their source of income, with lower-income households experiencing the highest impact. A number of these households used their savings to cushion food consumption; hence, food insecurity was not alarming. In South Africa, Arndt et al. (2020) found that households where members depend largely on labour income and possess lower educational qualification were at a higher risk of food insecurity, while Inegbedion (2020) whose study examined the implication of the lockdown induced by COVID-19 on food security using a cross-sectional survey elicited via social media found that the pandemic adversely affected transportation, security, and farm labour which may undermine the production of food and accelerate food insecurity in Nigeria.

Summarily, the vast body of literature on food security have identified several determinants of food security before the global effect of COVID-19, while studies that incorporated COVID-19 as a core threat to the achievement of food security both at the local, national, and global level have majorly assessed the extent of household food insecurity/security. Given the limited empirical evidence on Nigeria using a nationally representative data, this study addresses this gap in the literature by examining the level of food insecurity in Nigeria during the COVID-19 pandemic restrictions, while also identifying the factors that induce or minimize household food security in Nigeria.

3.0 Methodology and Data

3.1 Data

This study uses secondary data sourced from the Nigeria COVID-19 National Longitudinal Phone Survey (COVID-19 NLPS). This is a nationally representative cross-sectional survey of 1, 950 households drawn from the households surveyed in the 2018/2019 General Household Survey-Panel (Wave 4). This is part of the World Bank's Living Standard Measurement Study - Integrated Surveys on Agriculture (LSMS-ISA) conducted by the National Bureau of Statistics in collaboration with Bill and Melinda Gates Foundation (BMGF) and the World Bank (WB). The collection of this data commenced in April 2020 to monitor and enhance knowledge on the socioeconomic impact of COVID-19 pandemic in Nigeria. It contains data on food security, income, employment, coping strategies and other channels through which the pandemic can impact households. Besides, this study utilized round one and two of the COVID-19 NLPS with a total of 1821 households which covers the 36 states of Nigeria including the Federal Capital Territory (FCT).

3.2 Empirical Model Specification and Variable Selection

3.2.1 Dependent Variable

There are several means of estimating food security globally, however, this study alongside (Sadiddin, Cattaneo, Cirillo, & Miller, 2019) made use of the questions validated in the Food Security Experience Scale (FIES) developed by the FAO's Voice of the Hungry Project for measuring household food security. Responses from eight household questions covering the experience of food security produced a dichotomous response (yes/no) across each household. Following Ballard, Kepple and Cafiero (2013), households that experienced anxiety about having

enough to eat, being unable to eat healthy and nutritious preferred food due to lack of money/other resources or those who consumed only a few kinds of food due to financial restrictions and other constraints where considered to be mildly food insecure. Households that skipped a meal, ate less than expected to have or ran out of food due to lack of resources to access it were considered as moderately food insecure. Households where members experienced hunger and did not eat or those who went without eating for a whole day were categorised as severely food insecure. Meanwhile households that had no experience of these eight items were considered food secure. This, thusproduce an ordered response of households, ranging from those that are food secure to those who are severely food insecure (see Appendix 1).

3.2.2 Independent Variables

Based on the review of the empirical literature, some variables which had earlier been considered as factors determining food security in developing countries were selected. Since the focus is on the household and not individuals, variations in the socio-demographic characteristics of households are controlled by including variables such as age, gender, educational status, marital status of household head, household size and dependency ratio of the household while socioeconomic variables such as income, and wealth status were considered important in explaining differences in economic vulnerability of households. Focusing on the age of the household head in years, increases in the age is theoretically expected to increase welfare and reduce vulnerability due to asset accumulation, however, while Oyetunde-Usman and Olagunju, (2019) suggest that younger household heads are less vulnerable to food insecurity, Arene and Anyaeji (2010), and Abdullah et al. (2019) posits that households with older heads tend to experience food security, hence there is no clear consensus.

With respect to the gender of the household head which is also a widely recognised variable that affects economic welfare, studies like Delvaux and Paloma (2018), and Abdullah et al. (2019)) showed that male-headed households are less prone to food insecurity. However, this has been debated by authors who either found the gender disparity insignificant (Arene & Anyaeji, 2010; Ngema et al., 2018; Nwaka, 2019) or otherwise. Hence, there is a need to control for the effect of the gender of the household head during the COVID-19 pandemic. Similarly, education status of the household head has been found to have a significant effect on food security, given that improvements in educational attainment positively influence the ability to earn wages or income required to access food (Mallick & Rafi, 2010; Ngema et al., 2018). Following Becker (1974) theory of marriage whereby married persons are expected to have a comparative advantage over those unmarried, marital status was considered as a viable control variable. Meanwhile, the size of the household, as well as the dependency ratio, have been recognized as factors that influence food security (Delvaux & Paloma, 2018; Wolfson & Leung, 2020)

The socioeconomic factors considered in this study include total household income and the wealth status of the household. To capture the effect of COVID-19 pandemic on household income, questions were raised as to whether or not the total household income from the source of livelihood reduced, remained the same or increased during the pandemic. Besides, studies like Arene and Anyaeji (2010), Delvaux and Paloma (2018), Ngema et al. (2018), and Nwaka (2019) already suggest that increases in household income are associated with an increased likelihood of food security. On the other hand, wealth quintile of the household was estimated using principal component analysis (PCA) on variables that capture the household's standard of living such as household ownership of assets, housing characteristics and infrastucture (source of sanitation, and water amongst others). This approach is preferrable to the consumption or expenditure approach

because it is less volatile. Based on this, the wealth status of the households were estimated and the population was classified into quintiles which are a continuum of the poorest and the least poor (Gwatkin et al., 2007)

Some other controls such as the household experience of shocks and assistance were considered. Households that experienced disruptions of farming, livestock or fishing activities, a fall in the price of farming/business output or an increase, increases in the price of food items and so on were considered to be experiencing a shock (negative) during the COVID-19 pandemic. Meanwhile, funds were released by the Government (Federal, State or Local), community organizations, Non-governmental Organizations (NGO's), religious organisations and international bodies to cushion the effects of the spillover effects of the pandemic on individuals and households. While some households received assistance ranging from food items to direct cash transfers or in-kind transfers, some households did not. Since this was considered as an economic relief strategy, it was controlled for in this study. Additionally, community factors such as the sectorial location of the household in terms of "rural" or "urban" were considered alongside the geo-political zone from which the household was selected either in the Northern part of Nigeria or the Southern part in line with Wolfson and Leung (2020)

3.2.3 Model Specification

To investigate the determining factors influencing the household's food security status, different models have been used by researchers whose study utilized cross-sectional data. For instance, Abdullah et al. (2019) and Niles et al. (2020) used the logit model in predicting these factors, Oyetunde-Usman and Olagunju (2019) used the probit model, while Delvaux and Palom (2018) employed the multinomial logit model. Following (Greene, 2005), this study like Mallick and Rafi (2010) and Obayelu (2012) found the ordered probit (or logit) model more applicable given the

categorical and ordered nature of household food security status. Although there is no theoretical underpinning for selecting between logit and probit, since their inferences are similar, this study estimated an ordered probit regression constructed on an unobservable random variable stated in equation 1.

$$f^* = x'\beta + \varepsilon \tag{1}$$

Where f^* is the continuous and unobservable latent measure of food security, x' is the vector of independent variables affecting food security. β represents the coefficients or parameters to be estimated, and ε is the error term which is assumed to be normally distributed. The food security index is coded into four discrete categories, while f which can be observed is specified as

$$f = \begin{cases} 0 & \text{if } f^* \le 0, (\text{food secure}) \\ 1 & \text{if } 0 \prec f^* \le \mu_1 (\text{mild food insecurity}) \\ 2 & \text{if } \mu_1 \prec f^* \le \mu_2 (\text{moderate food insecurity}) \\ 3 & \text{if } \mu_2 \le f^* (\text{severe food insecurity}) \end{cases} \tag{2}$$

Where μ's are defined as unknown parameters to be estimated with β. Normalizing the mean and variance of the error term to zero and one, the probabilities associated with the coded depended variables are as follow:

$$\begin{aligned} &\Pr(f = 0 \mid x) = \Phi(-x'\beta), \\ &\Pr(f = 1 \mid x) = \Phi(\mu_1 - x'\beta) - \Phi(-x'\beta), \\ &\Pr(f = 2 \mid x) = \Phi(\mu_2 - x'\beta) - \Phi(\mu_1 - x'\beta), \\ &\Pr(f = 3 \mid x) = 1 - \Phi(\mu_2 - x'\beta) \end{aligned} \tag{3}$$

To have the probabilities as positive values, the following is required

$$0 \prec \mu_1 \prec \mu_2 \prec \mu_3 \tag{4}$$

Since the estimated coefficient from this model cannot be interpreted directly, this study also estimated the marginal effects wherein a change in one of the explanatory variables will lead to a change in the predicted distribution of the outcome variable as shown in equation 5.

$$\frac{\partial \Pr(f=0|x)}{\partial x} = -\varphi(x'\beta)\beta,$$
$$\frac{\partial \Pr(f=1|x)}{\partial x} = [\varphi(-x'\beta) - \varphi(\mu_1 - x'\beta)]\beta,$$
$$\frac{\partial \Pr(f=2|x)}{\partial x} = [\varphi(\mu_1 - x'\beta) - \varphi(\mu_2 - x'\beta)]\beta,$$
$$\frac{\partial \Pr(f=3|x)}{\partial x} = \varphi(\mu_2 - x'\beta)\beta \quad (5)$$

Where 0 through 3 represents the various categories of household food security status; x is the independent variable and μ's are the cut-off values for the ordered probit (Greene, 2005).

3.3 Data Analysis

This was carried out using STATA version 16.1 software.

4. Estimation Results

The descriptive statistics on all households covered in this study are presented in Table 1 and these comprise households proportionally distributed across the five geopolitical zones of the country. Approximately 50% of the households are located in the Northern and the Southern part of Nigeria respectively and the household heads are taken as representatives of the household given that the economic decisions of the household are largely influenced by the household head. A summary of their characteristics indicates that the mean age of household heads is 50 years with the youngest being 19 and the eldest being 99 years. The households generally comprised of about 6 persons (SD=3.6) on the average, even though household members ranged from 1 to 34 individuals, while

larger households were observed in the Northern Nigeria (mean □ 8) than the Southern Nigeria (mean □ 5). The dependency ratio ranged from 0 to 6 with an average of 1. Majority of household heads were male (89%) which is consistent with 2010 household data and it is an indication of patriarchal dominance in households.

Table 1: Summary Statistics of the Population's Characteristics

	Northern Nigeria (49.70%)				**Southern Nigeria (50.30%)**				**All Households (n=1821)**			
Variables	**Mean**	**Min**	**Max**	**SD**	**Mean**	**Min**	**Max**	**SD**	**Mean**	**Min**	**Max**	**SD**
Age of Household Head (years)	48.20	19	99	13.95	51.92	19	99	14.82	50.09	19	99	14.51
Household Size	7.57	1	34	4.08	4.66	1	18	2.33	6.10	1	34	3.62
Dependency Ratio	1.11	0	5.5	0.83	0.83	0	6	0.82	0.97	0	6	0.84
Household Shocks	2.79	0	8	1.94	2.30	0	8	1.40	2.54	0	8	1.71
Variables	**Percentage (%)**				**Percentage (%)**				**Percentage (%)**			
Gender of Household Head												
Male	89.44				75.00				82.15			
Female	10.56				25.00				17.85			
Marital Status of HH												
Unmarried	13.49				32.66				23.09			
Married	86.51				67.34				76.91			
Educational Status												
None	20.41				11.64				16.02			
Primary	32.09				31.41				31.75			
Jnr Secondary/Vocational	6.12				7.68				6.90			
Snr Secondary/A-Levels	20.86				29.27				25.07			
Tertiary	20.52				20.00				20.26			
Household Income												
Increased	4.99				4.71				4.85			
Remained the same	15.59				17.00				16.33			
Declined	79.42				78.29				78.82			
Assistance												
None	79.23				67.25				73.20			
Assisted	20.77				32.75				26.80			

Min denotes Minimum value, while Max represents the Maximum Value; SD means the standard deviation of the distribution.
Author's calculation based on the Nigeria COVID-19 NLPS data.

With respect to the level of education, 16% had no formal education, over one fourth had primary education, and an average of 20% was highly educated which includes attending the University or a school of Nursing. Interestingly, over three quarters (79%) of the population experienced a decline in total household income during the COVID-19 pandemic restrictions, while only 5% of the households experienced an increase in their total income. Besides, the majority (73%) of the

households in this study did not receive any food, financial, or in-kind assistance during this period to cushion the effect of the COVID-19 pandemic restrictions on household welfare.

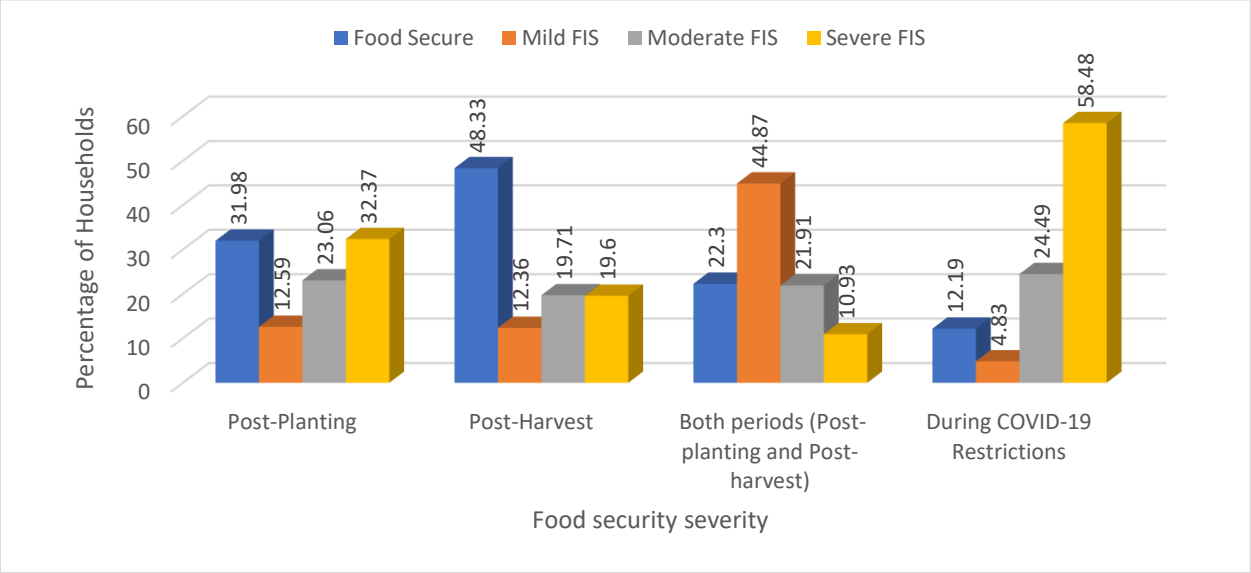

Figure 1: Descriptive Statistics of Food Security Indicators According to Season
Source: Merged datasets from 2018/2019 GHS data for both seasons and COVID-19 NLPS dataset.

Focusing on the major variable of interest, food security, findings from this study showed that more than half (58%) of the households experienced severe food insecurity during the COVID-19 pandemic restrictions, while 12%, 5% and 24% experienced food security, mild food insecurity and moderate food insecurity respectively. This experience of food insecurity is however much higher than it was for these households before the restrictions caused by the COVID-19 pandemic. For instance, about 32% of these household were food secure during the post-planting season and it increased to 48% during the post-harvesting period, while 22% of these households were consistently food secure during both seasons, unlike the significant drop in food security observed during the pandemic. On the other hand, the population of households experiencing severe food insecurity declined from 32% during the post-planting period to 20% during the post-harvesting period, with the percentage of households that consistently experienced severe food insecurity at 11%, unlike the very high level of severe food insecurity observed during the pandemic. All these

suggest that about 88% of these households were food insecure during the COVID-19 pandemic restrictions.

Further explaining the experience of food security during the pandemic, Table 2 shows that the percentage of household food security changes across wealth quintile. For instance, the highest percentage (21%) of households that are food secure during the pandemic are those who are in the least poor quintile, with the lowest percentage (7%) of households with food security being amongst the households in the poorest strata. Similarly, the other extreme (severe food insecurity) is observed to have been very high amongst those in the poorest quintile (72%), while less than half of those in the highest wealth strata experienced food insecurity during the COVID-19 pandemic restrictions.

Table 2: Experience of Food Security during COVID-19 Restrictions Across Wealth Quintile.

Ordered Value	**Food Security Status**	**Q1 (poorest)**	**Q2**	**Q3**	**Q4**	**Q5 (Least Poor)**
F = 0	Food Secure	6.53	9.25	8.97	9.66	20.94
F = 1	Mild Food Insecure	3.27	5.69	5.43	3.14	6.37
F = 2	Moderate Food Insecure	17.96	20.28	22.01	26.09	30.6
F = 3	Severe Food Insecure	72.24	64.77	63.59	61.11	42.09
χ^2	100.73	P-value	<0.001			

To explain the influence of socioeconomic and socio-demographic factors on food security in Nigeria, a total of 12 independent variables were included in the econometric model of which 6 variables had a significant influence on household food security (Table 3). The major variables that significantly influenced household food security during the COVID-19 pandemic restrictions were the level of education of the household head, changes in total household income, and the wealth status of the household. Meanwhile, the effect the experience of multiple shocks to the household, the sectoral as well as the zonal location of the household also affected the household food security status across different models. It is noteworthy that age-squared and household size

squared which was originally included in the model to capture their non-linear effects were dropped in the result presented because they did not improve the model significantly.

Table 3: Determinants of Food Security during COVID-19 Restrictions

Variables	**Model I**	**Model II**	**Model III**	**Model IV**	**Model V**
Age of Household Head	-0.004 (0.002)				-0.003 (0.002)
Gender of HH *(Male)*					
Female	-0.054 (0.118)				-0.059 (0.119)
Education of HH *(None)*					
Primary	-0.125 (0.096)				0.016 (0.104)
Jnr Secondary/Vocational	-0.286 (0.138)**				-0.175 (0.146)
Snr Secondary/A-Levels	-0.268 (0.107)**				-0.123 (0.118)
Highly Educated	-0.780 (0.103)***				-0.440 (0.121)***
Marital Status of HH *(Unmarried)*					
Married	-0.116 (0.111)				-0.050 (0.111)
Household Size	-0.004 (0.009)				0.008 (0.011)
Dependency Ratio	-0.008 (0.037)				-0.038 (0.038)
Income *(Increased)*					
Remained the same		0.306 (0.141)**			0.298 (0.148)**
Reduced		0.739 (0.126)***			0.683 (0.129)***
Wealth quintile *(Poorest)*					
Q2		-0.162 (0.117)			-0.236 (0.125)*
Q3		-0.239 (0.109)**			-0.320 (0.122)***
Q4		-0.274 (0.106)***			-0.344 (0.124)***
Q5 (Least Poor)		-0.736 (0.101)***			-0.712 (0.129)***
Shocks *(No/Single)*					
Multiple			0.183 (0.059)***		0.087 (0.068)
Assistance *(None)*					
Received			0.033 (0.062)		0.020 (0.069)
Sector *(Urban)*					
Rural				0.193 (0.062)***	0.012 (0.072)
Zone *(North Central)*					
North East				-0.037 (0.095)	-0.232 (0.110)**
North West				-0.146 (0.099)	-0.342 (0.116)***
South East				0.017 (0.093)	-0.044 (0.105)
South-South				-0.106 (0.096)	-0.078 (0.107)
South West				0.067 (0.097)	0.109 (0.105)
/cut1	-1.833 (0.187)***	-0.960 (0.151)***	-1.040 (0.056)***	-1.083 (0.080)***	-1.431 (0.250)***
/cut2	-1.615 (0.185)***	-0.736 (0.151)***	-0.826 (0.055)***	-0.870 (0.078)***	-1.206 (0.249)***
/cut3	-0.826 (0.182)***	0.056 (0.150)	-0.084 (0.052)	-0.127 (0.077)*	-0.372 (0.249)
Diagnostics (Model V)					
Wald Chi-square	185.61	P-value	<0.001		
_hat	0.931 (0.113)***	_hatsq	0.116 (0.145)		
Mean VIF	1.42				

HH represents the household head and ***, **, * represents significance levels of 1%, 5% and 10% respectively

The Wald chi-square value of 185.61 and a p-value of <0.001 suggests that the estimated model as a whole is statistically significant, the result from _hat and _hatsq suggest that the model is well specified, and estimations from the variance inflation factor (VIF) suggest the absence of severe

multicollinearity problem among the regressors in the model. Focusing on Model V, if the unobserved variable f^* takes the value less than -1.431, the ordinal regressand will take the value of 0 (food security). If it falls between -1.431 and -1.206, the ordinal regressand will take the value of 1 (mild food insecurity). If f^* falls between -1.206 and -0.372, the ordinal regressand will assume the value of 2 (moderate food insecurity), and if the unobserved variable takes a value more than -0.372, the households will be considered severely food insecure.

Explaining further the determinants of food security during the COVID-19 pandemic restrictions, Table 4 presents the marginal effects of the significant independent variables. This provides insight into the positive or negative changes in food security status induced by these factors. For instance, households with highly educated heads were about 8.5 percentage points more likely to experience food security and approximately 16 percentage points less likely to experience severe food insecurity, on the average than households whose heads have no formal education. This implies that having a household head who is highly educated has a strong significantly positive effect on food security and a strong significantly negative effect on severe food insecurity.

Concerning the total household income, during the COVID-19 pandemic restrictions, households whose total income remained the same were 8 percentage points less likely to experience food security during the restriction, 1.3 percentage points and 1.7 percentage points less likely to experience mild and moderate food insecurity respectively, but 11 percentage points more likely to experience severe food insecurity during the COVID-19 pandemic restriction than households whose income increased during the same period. Similarly, households with reduced income during this period were approximately 16 percentage points less likely to experience food security, 3 percentage points and 7 percentage points less likely to experience mild and moderate food

insecurity respectively, but 25 percentage points more likely to experience severe food insecurity during the COVID-19 pandemic restrictions than households whose total income increased.

Table 4: Marginal Effect of Independent Variables on Food Security

Variables	**Elasticity**			
	f = 0 (Food Security)	**f = 1 (Mild Food Insecure)**	**f = 2 (Moderate Food Insecure)**	**f = 3 (Severe Food Insecure)**
Education of HH				
None	1.00			
Primary	-0.002 (0.015)	-0.001 (0.005)	-0.003 (0.017)	0.006 (0.037)
Jnr Secondary/Vocational	0.029 (0.025)	0.008 (0.007)	0.026 (0.022)	-0.064 (0.053)
Snr Secondary/A-Levels	0.020 (0.019)	0.006 (0.006)	0.019 (0.019)	-0.045 (0.043)
Highly Educated	0.085 (0.022)***	0.021 (0.006)***	0.057 (0.017)***	-0.164 (0.045)***
Household Income				
Increased	1.00			
Remained the same	-0.080 (0.042)*	-0.013 (0.006)**	-0.017 (0.008)**	0.110 (0.054)**
Reduced	-0.156 (0.038)***	-0.031 (0.006)***	-0.066 (0.007)***	0.254 (0.046)***
Wealth Quintile				
Q1	1.00			
Q2	0.029 (0.015)*	0.010 (0.005)*	0.040 (0.021)*	-0.080 (0.042)*
Q3	0.042 (0.015)***	0.014 (0.005) ***	0.054 (0.021) ***	-0.110 (0.041) ***
Q4	0.046 (0.016) ***	0.015 (0.005)	0.058 (0.021) ***	-0.119 (0.041) ***
Q5	0.121 (0.020) ***	0.033 (0.007) ***	0.104 (0.020) ***	-0.258 (0.044) ***
Zone				
North Central	1.00			
North East	0.042 (0.021)**	0.010 (0.005)**	0.031 (0.014)**	-0.083 (0.039)**
North West	0.066 (0.024)***	0.015 (0.005)***	0.042 (0.014)***	-0.124 (0.042)***
South East	0.007 (0.017)	0.002 (0.005)	0.006 (0.015)	-0.016 (0.037)
South South	0.013 (0.018)	0.003 (0.005)	0.011 (0.015)	-0.027 (0.038)
South West	-0.016 (0.016)	-0.005 (0.004)	-0.016 (0.016)	0.037 (0.036)
Predicted Probabilities	0.114	0.045	0.249	0.592

The dependent variable is the food security status. The model includes the age of household head, the gender of household head, dependency ration, household size, marital status of household head, shocks, assistance and sector but they are not reported because they have an insignificant effect on food security. Marginal effects are presented and robust standard errors are in parenthesis. *** p<0.01, ** p<0.05, * p<0.1

The wealth status of the household also had a strongly significant effect on the food security status of the household. Wherein, households in the second socioeconomic quintile were 3 percentage points more likely to experience food security than those in the poorest quintile, while they were also 8 percentage points less likely to experience severe food insecurity than households in the poorest quintile. This progresses to the fifth quintile, where households are 12 percentage points more likely to experience food security than households in the poorest quintile, and these least poor households were equally 29 percentage points less likely to experience severe food insecurity

compared with households in the poorest wealth quintile. Furthermore, the geographic location of the households offered some insights. Households in the North-Eastern Part of Nigeria and North-western Part of Nigeria were 4 and 7 percentage point more likely to be food secure respectively, while they were also 8 and 12 percentage points less likely to be severely food insecure respectively compared with those located in North Central Nigeria.

4.0 Discussion of Findings

The results presented throughout this study showed the significant effect of socioeconomic determinants on the severity of food security among Nigerian households during the COVID-19 pandemic. Employing a nationally representative data, it was discovered that more than half of the households experienced severe food insecurity irrespective of the sectoral distribution (rural or urban), while 12 per cent experienced food security. This level of food insecurity is remarkably higher than reported by the same households before the pandemic. Although it is not unexpected given the physical and social restrictions that were put in place to curb the spread of the virus, this disparity across socioeconomic quintile threatens to greatly exacerbate the existing level of inequality. Evidence from Niles et al. (2020), Shupler et al. (2020) alongside Wolfson and Leung (2020) provides empirical support of the increased level of food insecurity experienced during the pandemic.

This study further demonstrates that the main factors that influenced food insecurity during the COVID-19 pandemic restrictions are socioeconomic factors rather than demographic factors. While earlier studies (Mallick & Rafi, 2010; Obayelu, 2012; Olabiyi & McIntyre, 2014; Abdullah et al., 2019) that evaluated the determinants of food security found age, gender, household size, sectoral distribution, and dependency ration as significant factors, this study found that the level of education of the household head, income and the wealth status of the household are the dominant

factors during the pandemic. For the level of education, the findings of the study showed that highly educated household heads were less likely to be severely food insecure and more likely to be food secure. This is in agreement with a priori expectation which suggests that a higher level of education improves household economic welfare because it can influence the ability to earn wages or income required to access food, thereby improving food security and it is in conformity with Mallick and Rafi (2010), Ngema et al. (2018), and Abdullah et al. (2019).

Importantly, a reduction in the total household income significantly increased the likelihood of a household experiencing food insecurity during the COVID-19 pandemic. Given that a negative shock to household income serves as an economic constraint to utility maximization. Arndt et al. (2020), Wolfson and Leung (2020), Shupler et al. (2020), and Niles et al. (2020) in conformity with this study showed that a reduction in the total household income jeopardizes household food security during the pandemic. Besides, the wealth status of the household also significantly influenced the probability of experiencing food security. That is, less poor households had a lower probability of being food insecure, while poorer households were more vulnerable to food insecurity during the pandemic. This result is also consistent with the a priori expectation, Harris-Fry et al. (2015), and Abdullah et al. (2019).

5.0 Conclusion

This study investigated the extent of food security among Nigerian households during the COVID-19 pandemic restrictions and the factors that influence the household's food security status using nationally representative data. Using the food insecurity experience scale to assess the extent of food security, it was discovered that more than half of the households experienced severe food insecurity during the pandemic and the dominant determinant of food security was the socioeconomic status of the household in terms of education, income and wealth status. This

suggests that households in the lower socioeconomic class were disproportionately affected by the pandemic. The findings of this study showed that a small proportion of households received assistance (food, cash or in-kind) assistance during the pandemic; hence, this study suggests that Nigerian government and other development agencies need to provide more support or grants to households (particularly those with low socioeconomic status) so as minimize the shock and aid the recovery of household food security during and post COVID-19.

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Appendix

Appendix 1: Summary of the Variables Specified in The Ordered Probit Model

Variable	Variable Meaning	Types of measure	A priori Expectation with respect to food security
Food Security	Whether a household is food secure, mild food insecure,	Dummy (FS=0. MFIS=1, MOFIS=2, SFIS=3)	

	moderate food insecure, or severe food insecure during COVID-19 pandemic restrictions		
Age	Age of the household head (in years)	continuous	±
Gender	Sex of household head	Dummy (Male=0, female=1)	±
Marital Status	The proportion of married or unmarried household heads	Dummy (married=1, otherwise=0)	+
Education	The educational level of the household head	Dummy (No formal education=0, Primary Education =1, Junior Secondary/Vocational College =2, Senior Secondary/A Levels=3, Highly Educated =4	+
Household Size	Number of children and adults that reside within the household	Continuous	±
Dependency Ratio	The ratio of the number of non-working members of the household (below 15 and above 65 years) to total household size	Continuous	-
Income	Changes in total household income during COVID-19 pandemic restrictions	Dummy (increased=1, stayed the same=2, reduced=3)	+
Socioeconomic quintile	This is the socioeconomic status of the household from the 1st quintile (poorest) to the 5th quintile (least poor)	Dummy (ranging from Poorest=1 to least poor=5)	+
Shock	This is the number of shocks experienced by the household	Dummy (one or no shock=0, multiple shock=1)	–
Assistance	Assistance received by the household in food, cash or kind during the COVID-19 restrictions.	Dummy (No assistance=0, otherwise=1)	+
Sector	Whether household resides in a rural or an urban sector.	Dummy (Urban=0, Rural=1)	±
Zone	Whether households reside in North Central, North East, North West, South East, South-South or South-West Nigeria	Dummy (ranging from 1 for North Central to 6 for South West)	±